DOCUMENT RESUME

ED 097 230 SE 018 458

AUTHOR Waits, Bert K.; Riner, John W.
TITLE A Brief History and Description of CRIMEL--A Curriculum Revision Project Designed to Individualize Instruction in Beginning College Mathematics.
INSTITUTION Ohio State Univ., Columbus. Dept. of Mathematics.
PUB DATE [74]
NOTE 10p.

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS Class Organization; *College Mathematics; *Curriculum; *Instruction; Instructional Media; Mathematics Education; *Program Descriptions

ABSTRACT

Details are given of the background and organization of the Curriculum Revision and Instruction in Mathematics at the Elementary Level (CRIMEL) program for undergraduates at The Ohio State University. The first three years of the program are discussed; administrative problems in grouping students for instruction, attempts to use multimedia methods of instruction, and the test-retest program are described. (DT)

U S DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

ED 097230

A Brief History and Description of CRIMEL -- A Curriculum Revision Project Designed to Individualize Instruction in Beginning College Mathematics

by

Bert K. Waits and John W. Riner
Department of Mathematics
The Ohio State University

INTRODUCTION. For a number of years in the Mathematics Department at The Ohio State University we have been making a serious attempt to provide instruction in elementary courses in a way that takes into account the background, interest, ability, motivation and needs of the individual student [10]. Our instructional task at Ohio State is quite large. In addition, our students have an extremely wide range of backgrounds and abilities because, by law, Ohio State must accept any Ohio high school graduate. Closed circuit television and lecture-recitation instructional techniques that were developed in the late fifties and that are still used in most large enrollment courses involve rigid curricula presented in lock-step fashion [11]. These techniques were brought about by the rapid growth of college enrollments and the even more rapidly growing demand for mathematics in the early sixties. They were successful for a majority of students. However, in a time when the student found it increasingly difficult to retain his individuality, we felt it was important that an instructional system be developed with the intrinsic flexibility to better deal with individual differences -- a working system that would make use of recent technology in order to optimize the effectiveness of our most important instructional resource, the classroom teacher. CRIMEL[1] at Ohio State is such a system. Ultimately,

[1] Curriculum Revision and Instruction in Mathematics at the Elementary Level.

SE 018 458

we hope the teacher will be able to devote more time to the individual student and his unique needs. The reader should note that our philosophy, experiences and instructional techniques are applicable to a variety of courses in other academic areas in high school or college.

THE FIRST YEAR. CRIMEL was originated by Professors Robert Fisher, John Riner and others at Ohio State in the late sixties. After several quarters of planning, discussions with various college curriculum committees, the creation of an innovative textbook [6] and a pilot experiment, the first year of CRIMEL was launched Autumn Quarter, 1970 [7] and [8]. Several existing five-quarter-hour mathematics courses were divided into three-hour and two-hour "mini-courses." These "mini-courses" were the first approximation to modules -- instructional packages of one to four weeks in length. Combinations of the "mini-courses" were used to create pacing flexibility. Material common to the three introductory courses (a brief but thorough precalculus review) was grouped together to form the first "mini-course."

About 25% of our students who, based on prior experience, were judged likely to have failed or to have dropped the traditional course in the past were transferred to "reduced pace" sections. These students spent the entire quarter on the first "mini-course" - three credit hours. In addition, about 10% of our students who were usually bored in the traditional courses were given the opportunity to accelerate their pace of study and complete three "mini-courses," seven or eight credit hours, in one quarter. The achievement standards were the same regardless of pacing level. Basic instruction within CRIMEL the first year was provided by way of televised lectures and daily recitations conducted by teaching assistants (a traditional "mass" technique).

The first year of CRIMEL was not really "individualized instruction." However, it was an important, and necessary, first step. It was important because it was successful -- more students were able to achieve at an acceptable level than ever before [1] and [3]. We did, however, encounter several problems that led to modifications during our second year of operation. Morale in the reduced pace sections was not good. We realized that we should have emphasized that the ultimate pacing decision was up to the student. Another basic problem centered around developing an effective administrative structure. An efficient and readily accessible way of maintaining student testing records (recording their progress) and "keeping track" of students was obviously needed as well as a better way to provide student counseling. Traditional courses left little room for student decisions and, consequently, there was not much need for student counseling, while the CRIMEL program placed increased responsibility on the student. It became necessary for the "system" to provide a mechanism for thoughtful counseling and advice easily accessible to the student who needed it.

THE SECOND YEAR. As the result of our initial experience we created the "teaching cluster" -- about 150 students, five teaching assistants, an undergraduate aide and a "cluster leader," an experienced teaching associate who had demonstrated leadership ability -- to decentralize our administrative structure for the second year (1971-1972). The cluster leader was responsible for keeping track of his 150 students and assisting the classroom teachers to become more effective in the classroom. The role of the cluster leader evolved into one primarily of counseling -- both students and teachers. It was hoped that every student could more easily identify with his cluster leader (much as he identifies

with a traditional teacher) even though he would sometimes change classroom teachers. All appropriate pacing opportunities were provided for each student within his cluster [12].

In the second year we also began to use closed circuit television as a "visual aid" rather than in the traditional lecture presentation mode. Also the telelessons were available to the classroom teacher on a flexible basis. The classroom teacher could "pick and choose" among several telelessons on any given day. This was accomplished by using three different closed-circuit TV channels and by providing tape playbacks at two different times during the class period [9]. The telelessons were also shown in the evening for viewing or reviewing by the student.

Probably the most important and most popular new feature was the adoption of a flexible-retesting program [2]. This was a natural and essential step in the direction of individualized instruction. A "test center" was provided where a student could take a test when he felt ready. In addition, if he did not do well, or as well as he thought he should, he was given the opportunity to retake the test to demonstrate that he could do better and thus earn a higher grade. The retest feature provided a strong incentive for the student to restudy (learn) the material. This policy necessitated the creation of many different, but equivalent, tests over the same material.

We also elected to use tests that required the students to produce an answer and show his work rather than using popular machine-graded, multiple-choice tests [13] and [14]. This was a costly, time-consuming move on our part. But, because we are responsible for the training of future scientists, engineers and economists, we felt it was important for such students to learn to communicate using mathematics as soon as possible. An effort was made to point out the students' errors in addition to simply scoring the tests.

We also further developed our several alternative modes of instruction -- CAI (computer-assisted instruction), individual tutoring, written textual and supplementary material, and of course, the use of regular classrooms. A computer-assisted record system (CARS) was developed for use during the second year of operation [4].

We anticipated (correctly) that the CRIMEL program would place a strain on our teachers. One of the rewards of teaching is to watch (and cause) a class to grow and finally succeed at the end. In CRIMEL, or any system of individualized instruction, long-term associations between a class and one teacher are less frequent. However, we feel the CRIMEL program offers the student considerably more flexibility and increased opportunities for learning than is possible with our traditionally-staffed sections of large-enrollment freshman courses.

Other problems also surfaced. Students (and teachers) complained about the seemingly frequent collapsing of sections within the cluster. Providing alternative pacing modes has not come easily. Certain regular-paced sections had to be dissolved and the teachers used to staff "reduced-paced" sections. We felt that adding more students and teachers to the cluster for the third-year operation would give us more flexibility and create less needless student shuffling. Retesting was limited only by a waiting period of two days between attempts and by the policy that a student could no longer retest after he scheduled the test over the next module. Many of our students were not able to study for retests and at the same time make satisfactory progress on the next module. It was hoped that by restricting the interval for retesting and limiting the number of retests this problem could be minimized.

In the second year of CRIMEL the telelessons were not very popular (only about 10% of the students said that they found them helpful) and hence not too

effective. In an effort to improve the telelessons, suggestions were solicited from students and teachers. New telelessons that were developed for the third year included a great deal of animation (some computer generated) along with interesting motivational and illustrative examples.

THE THIRD YEAR. In the third year of operation (1972-1973) of the CRIMEL program, we again decentralized our operation using the cluster approach. We increased the cluster size to about 300 students, which allowed for more flexibility. By beginning with overloaded sections (up to 35 students) we were able to hold back several teachers per cluster to staff the "reduced-pace" sections as the need developed. Thus very few students had to change teachers needlessly. This move was well received by both students and teachers.

Several steps were taken to involve the teacher in the actual operation of the Cluster. The role of the classroom teacher as a counselor was stressed. Students desiring the classroom environment (those who did not wish to work independently) were asked to see their classroom teachers for help outside of class whenever possible. Consequently most teachers had a group of students that they could claim as "their own" for a reasonable period of time. In general, students used the tutor room only when they found it impossible or very inconvenient to see their classroom teachers. Of course, students working independently or students needing additional help used the tutor room more frequently.

The flexible-retesting program was continued with several modifications. The retesting policy was restricted as mentioned earlier. Restricting the retesting had no apparent effect on achievement. In fact, there is evidence to suggest that limiting the retests had a positive effect on achievement. It seems that the important fact, from the student viewpoint, was that a second chance was permitted. The fact that the student also knew he had only a limited

number of chances caused him to view each attempt more seriously.

The student was again able to schedule his tests at a convenient time in a testing center (a daily capacity of over 1000 students) and had the opportunity to retake tests (usually limited to one over each module) to demonstrate improved understanding of the subject matter. The series of new telelessons were again shown in the classrooms on a flexible basis similar to the second year and were more popular than during the second year. The telelessons were also made available on videocassettes for individual viewing or reviewing at the University Learning Resources Center.

Other changes for the third year of CRIMEL included developing five two-to-three week (average pace) modules on basic algebra, functions and graphing, transcendental functions, trigonometry and complex numbers, and elementary differential calculus. The last two modules could be taken concurrently. Supplementary problem solution television tapes for each section of the first three modules were also created for use on videocassette players for individualized viewing. Special provisions were made for students who wished to work independently (self paced; using the tutor room, videocassettes, CAI, etc.) rather than attend a regular class. Developmental and experiemental work with CAI, computer-generated animation for instructional film use, and CMI (computer managed instruction) were continued.

Our videocassettes were extremely popular [15]. Students were able to view or review desired portions (maybe several times) of each telelesson and problem tape on an individual basis at The Learning Resources Center. It is interesting to note that most students who did not find the telelessons or problem tapes helpful over closed circuit TV thought they were very helpful when viewed on the individual videocassette players.

Significantly more students used CAI than ever before (about 200). However, only about half of them found it was very helpful. We expect more students to find CAI useful when the language and symbolism problems are worked out.

Many problems of the past have been resolved. Some students still feel our grading policy (no partial credit is given on tests in the first three modules) is too harsh. There are several reasons (budgetary and pedagogical) why we felt we must adopt this policy. We are presently investigating the possibility of giving some partial credit in the beginning modules. Now that our graders are more experienced, this is not a completely unrealistic goal.

We are still seeking new ways to make our teachers' involvement more truly satisfactory. We are making the use of the telelessons optional, allowing some classroom teachers to use them as they see fit. Less experienced teachers must rely on them to a greater extent than would many experienced teachers. The telelessons would also be available to any student for individual viewing on videocassettes.

THE FOURTH YEAR. In our fourth year of operation (1973-1974), we are implementing the first stage of CRIMELizing our remedial algebra course as well as extending CRIMEL to our beginning business calculus course. In addition, we are continuing to revise the curriculum and make administrative adjustments in the operation of the program [5].

CONCLUDING REMARKS. It has been long recognized that all students do not learn mathematics (or any other subject) at the same pace or through the same method of instruction. CRIMEL is a beginning -- an attempt to provide a vehicle for individualizing instruction and implementing a multi-media instructional approach. One very satisfactory result of CRIMEL has been that our department (and maybe

even mathematics itself) is viewed by the student in a favorable light. They believe we care. We always have, but CRIMEL is more "visible" evidence. Also through CRIMEL we believe we are satisfying more students (while upholding academic standards) than at any time in the past -- an important factor in today's universities.

A sometimes overlooked, but very important, indirect benefit of CRIMEL is that our students are "checkmated" into making decisions concerning their future at an early stage. No student in CRIMEL is forced into a particular pacing level. He must make important academic decisions (of course with advice) several times during the quarter. We believe that too often today in colleges and universities a student simply drifts from one course to another, from one program to another, without really thinking about his future. We believe our program is a step in the right direction -- assisting our students to become independent, thinking citizens in addition to sharpening their mathematical skills. It has not been an easy task, but much is at stake. We believe that it is worth the efforts.

For further information regarding CRIMEL, please write to: Professor Bert Waits, Director of the CRIMEL Program, The Ohio State University, Columbus, Ohio 43210.

REFERENCES

[1] Coon, Larry, "Long Term Effects of Acceleration on Undergraduate Calculus Students in the CRIMEL Program at The Ohio State University," unpublished Ph.D. dissertation, The Ohio State University, 1973.

[2] Elbrink, L. C., "A Flexible and Forgiving Testing Program," School Science and Mathematics, Vol. LXXII, Number 8, pp. 686-690, November, 1973.

[3] Mader, David, G., "Selection of Students for Individually Paced Sections of a College Freshman Mathematics Course," unpublished Ph.D. dissertation, The Ohio State University, June, 1971.

[4] Mader, David G., "A Computer Assisted System for Maintaining Information Flow on Student Records in a Large Enrollment Individualized Instruction Program," unpublished report, The Ohio State University, April, 1972.

[5] Matthews, Frank, "An Investigation of the Practicability of the Use of Students' Perceived Needs to Control the Rate of Progress of Instruction -- An Innovative CRIMEL Cluster," paper presented at the American Educational Research Association Annual Meeting, Chicago, April, 1974.

[6] L'Hirc, A., Introductory Mathematics, Charles Merrill Publishing Company, Inc., Columbus, Ohio, 1974.

[7] Riner, John W., "Individualizing Mathematics Instruction," American Mathematical Monthly, January, 1972.

[8] Riner, John W., "A New Approach to Mass Instruction," CUPM Newsletter, Number 7, pp. 13-15, February, 1972.

[9] Riner, John W. and Waits, Bert K., "The Uses of Instructional Television in Mathematics at The Ohio State University," Educational and Industrial Television, October, 1973.

[10] Riner, John W. and Waits, Bert K., "Individualized Instruction - A Viable Alternative," invited lecture presented at the annual meeting of the Mathematics Association of America in Dallas, Texas, January, 1973.

[11] Waits, Bert K., "Relative Effectiveness of Two Different Television Techniques and One Large Lecture Technique for Teaching Large Enrollment College Mathematics Courses," Educational Studies in Mathematics, Vol. 2, Number 4, February, 1970.

[12] Waits, Bert K., "Individualized Instruction in Large Enrollment Mathematics Courses," American Mathematical Monthly, March, 1973.

[13] Waits, Bert K. and Silver, Jerry, "Multiple Choice Examinations in Mathematics -- Not Valid for Everyone," American Mathematical Monthly, October, 1973.

[14] Waits, Bert K. and Elbrink, L. C., "A Statistical Analysis of Multiple Choice Examinations in Mathematics," The Two Year College Mathematics Journal, Vol. 1, Number 1, Spring, 1970.

[15] Waits, Bert K., "Instructional Videocassettes in Mathematics," to appear in the Two Year College Mathematics Journal.